

Thoracic Outlet Syndrome (TOS)

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- Thoracic outlet syndrome (TOS) is a condition that involves the:
- compression of the brachial plexus and its accompanying artery between the anterior and middle scalene muscles (**anterior scalene syndrome**)
- or between the coracoid process and the pectoralis minor muscle (**pectoralis minor syndrome**)
- or between the clavicle and the first rib (**costoclavicular syndrome**).

Structures Involved

- Brachial plexus (C5–T1)
- Subclavian artery & vein
- Lymphatic vessels

Supplies entire upper limb

Types of TOS

- Neurogenic (most common)
- Vascular
- Mixed

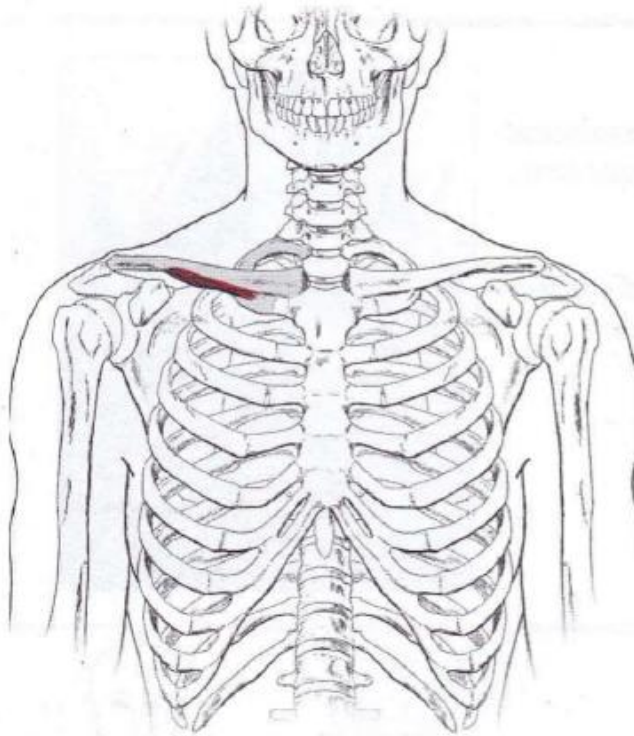
TOS:Causes

Causes :

- **internal** (bony callus, cervical rib) or **external** compression (crutches);
- **prolonged poor positioning; poor posture**, such as hyperkyphosis and scoliosis, muscle hypertonicity and trigger points;
- **systemic immune or metabolic disorders**, such as rheumatoid arthritis, diabetes and hypothyroidism;
- **trauma** with inflammation and subsequent scarring as with, for example, whiplash;
- **joint subluxation** of the cervical spine;
- **pregnancy**, which causes a combination of increased fluid retention and postural changes.

Subclavius

ProHealth



O 1st rib (junction of costocartilage)

I middle 1/3 of clavicle (inferior surface)

A assists in stabilization of clavicle
depression of clavicle
elevation of 1st rib

N nerve to subclavius (C5, C6)

B clavicular branch of thoracoacromial artery

Clinical Notes

- *Subclavius* may play a role in compression of the brachial plexus & subclavian artery & vein, which run between the clavicle & the anterior rib cage & can cause thoracic outlet syndrome (specifically costoclavicular syndrome)

Costoclavicular Syndrome

- **Costoclavicular Syndrome** is a specific type of **Thoracic Outlet Syndrome (TOS)** where compression happens in the **costoclavicular space**.

What is Costoclavicular Syndrome?

- Compression of:
 - **Brachial plexus**
 - **Subclavian artery & vein**
- Occurs **between the clavicle and first rib**
This space narrows when shoulders are **pulled down/back** or with poor posture.

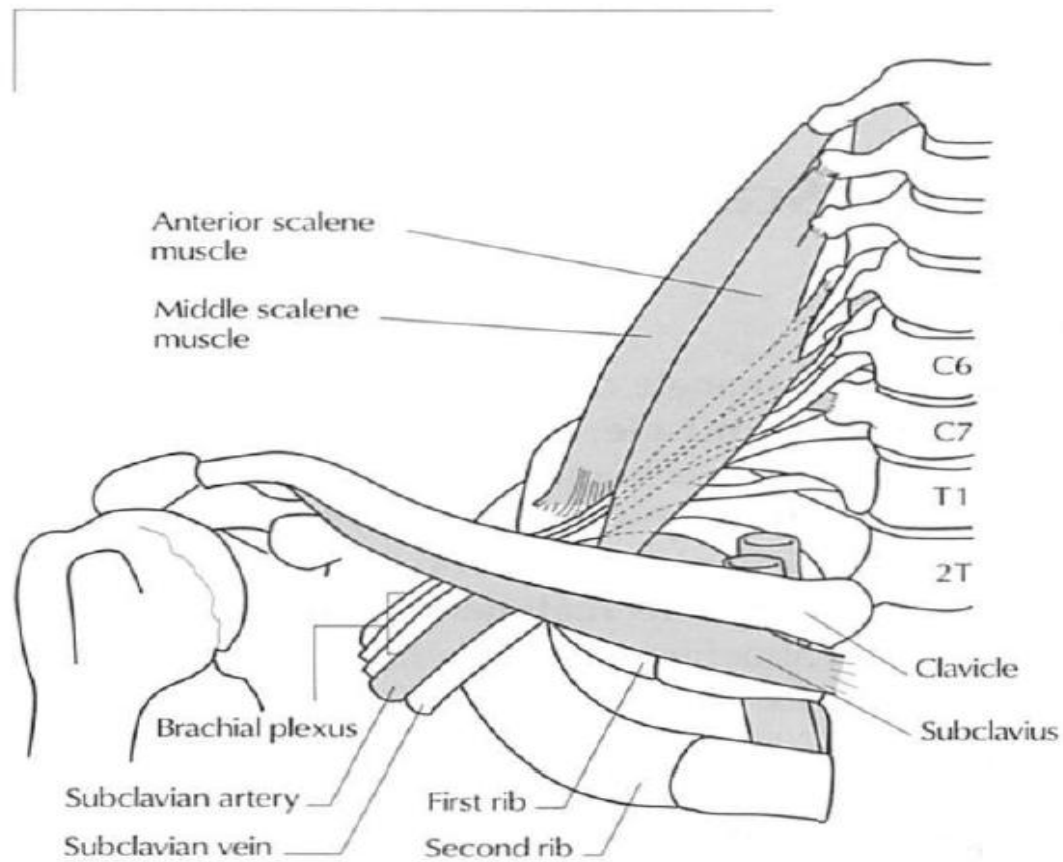


Figure 68.3

Subclavius inserts on the inferior surface of the clavicle. If it is hypertonic, it can contribute to brachial plexus compression.

Causes: Costoclavicular Syndrome

- Drooping shoulders (common in tall/thin individuals)
- Carrying heavy backpacks or bags
- Poor posture (military posture or slouching)
- Clavicle fracture or deformity
- Tight **subclavius**

Pathophysiology

- Narrowing of costoclavicular space → compression of neurovascular bundle
- Leads to:
 - Nerve ischemia → paresthesia
 - Vascular compromise → circulation issues

Symptoms:

Neurological

- Numbness & tingling in arm/hand
- Weak grip
- Pain in shoulder, arm, forearm

Vascular

- Cold hand
- Pallor or cyanosis (**Cyanosis** is a clinical sign where the **skin, lips, or nails turn bluish** due to **low oxygen levels in the blood**)
- Swelling (especially hand)

Aggravating Positions

- Carrying weight (bags, groceries)
- Shoulder retraction (military posture)
- Prolonged downward pull on shoulders

Costoclavicular: SOT

Costoclavicular Maneuver



Synonym: Eden's Test, Military Brace Test

Procedure

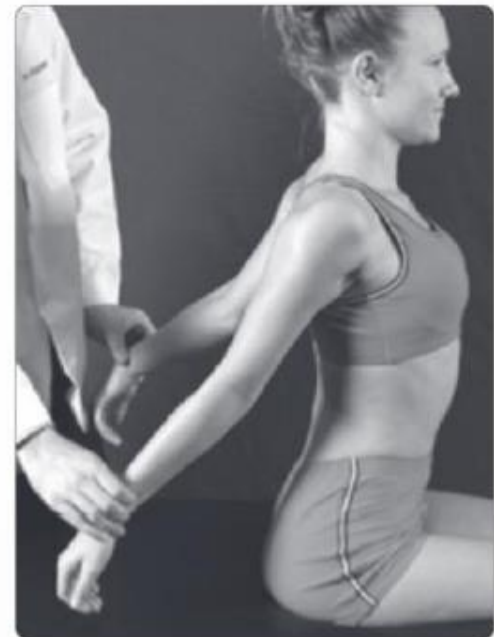
Patient seated, examiner bilaterally palpates radial pulse & pulls patient's arms into extension ("exaggerated military posture")
examiner may ask patient to roll shoulders back & take in a deep breath & hold

Interpretation

- (+) Diminished pulse → costoclavicular TOS
- (+) Arm pain, numbness, tingling → neurologic TOS (SP: 89-100)^{17, 18}

Clinical notes

Test provides particularly relevant information in patient's who display symptoms while wearing backpacks or other heavy items over shoulders



Cervical Rib in Thoracic Outlet Syndrome (TOS)

What is a Cervical Rib?

- An **extra rib arising from C7 vertebra**
- Congenital (present since birth)
- Can be:
 - Fully formed rib
 - Fibrous band (incomplete rib)
- Not everyone with a cervical rib has symptoms—but it can **predispose to TOS**
- **How it Causes TOS**
- The cervical rib **reduces space in the thoracic outlet**
- Compresses:
 - **Brachial plexus** → neurogenic symptoms
 - **Subclavian artery** → vascular symptoms

Compression usually occurs in the **interscalene triangle**

Such ribs are identified by X-ray and through palpation, at the level of the clavicle, as a bulge in the space between the anterior and middle scalenes.

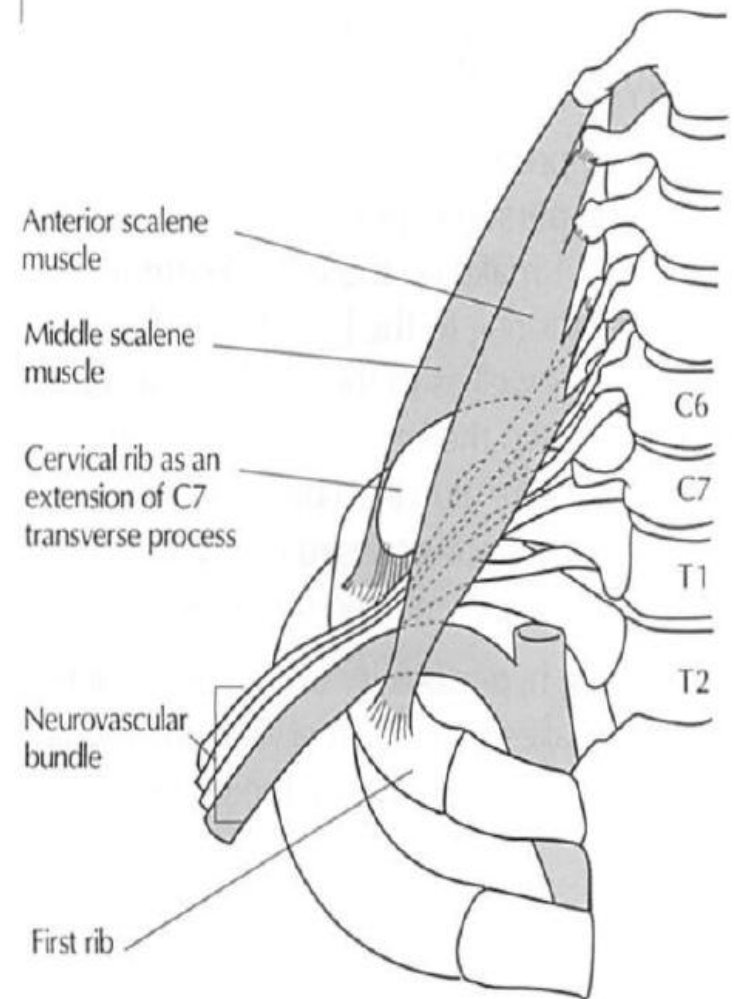
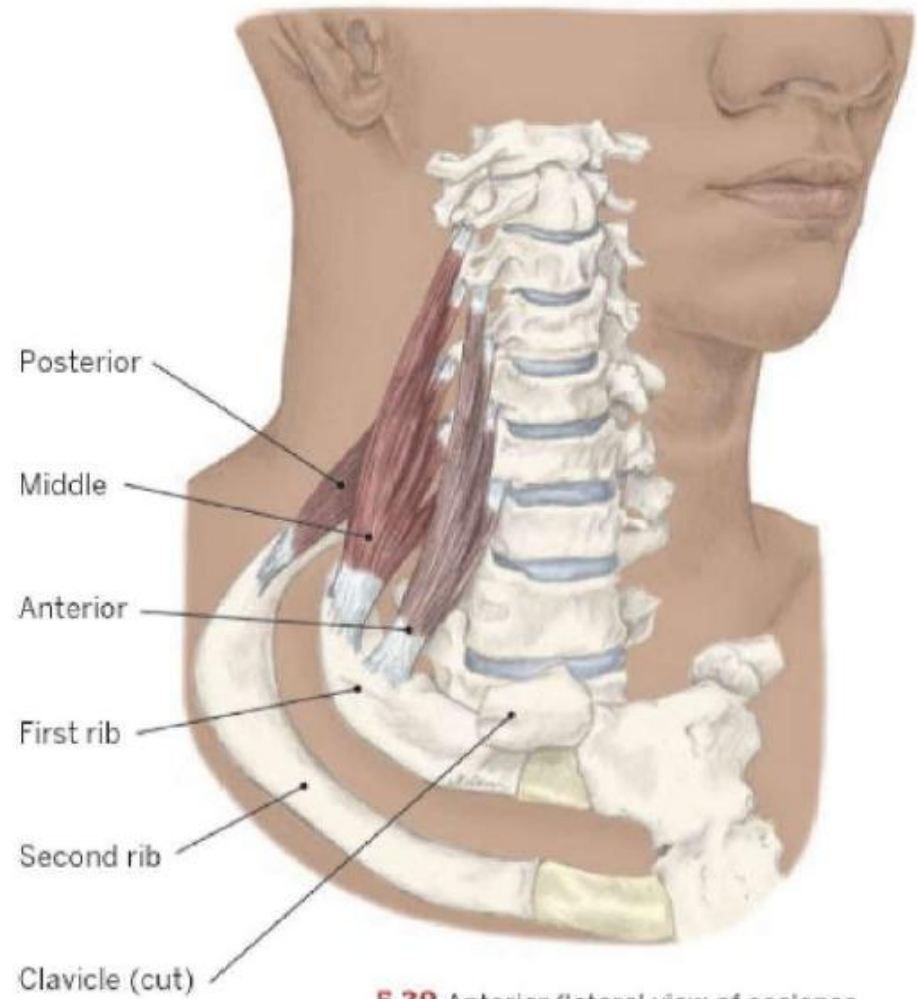


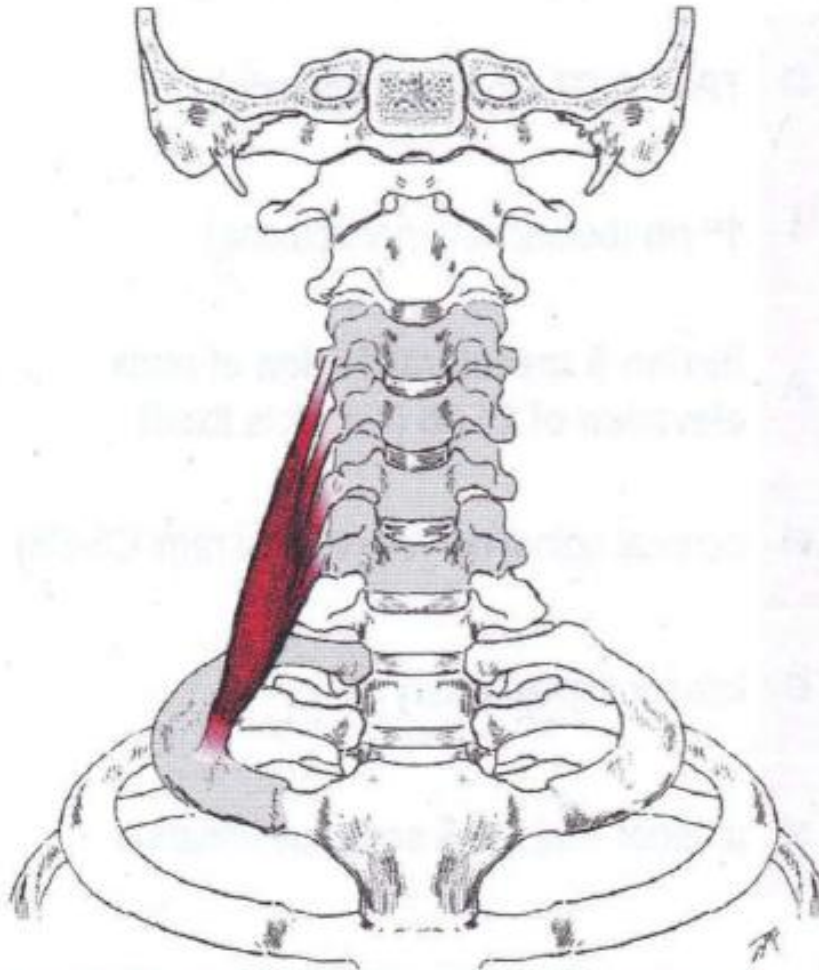
Figure 68.1

The presence of a cervical rib narrows the interscalene triangle.

scalenes



5.39 Anterior/lateral view of scalenes



O TPs of C3-C6 (anterior tubercles)

I 1st rib (scalene tubercle)

A flexion & ipsilateral flexion of neck
elevation of 1st rib (if neck is stabilized)
contralateral rotation of neck (weak action)

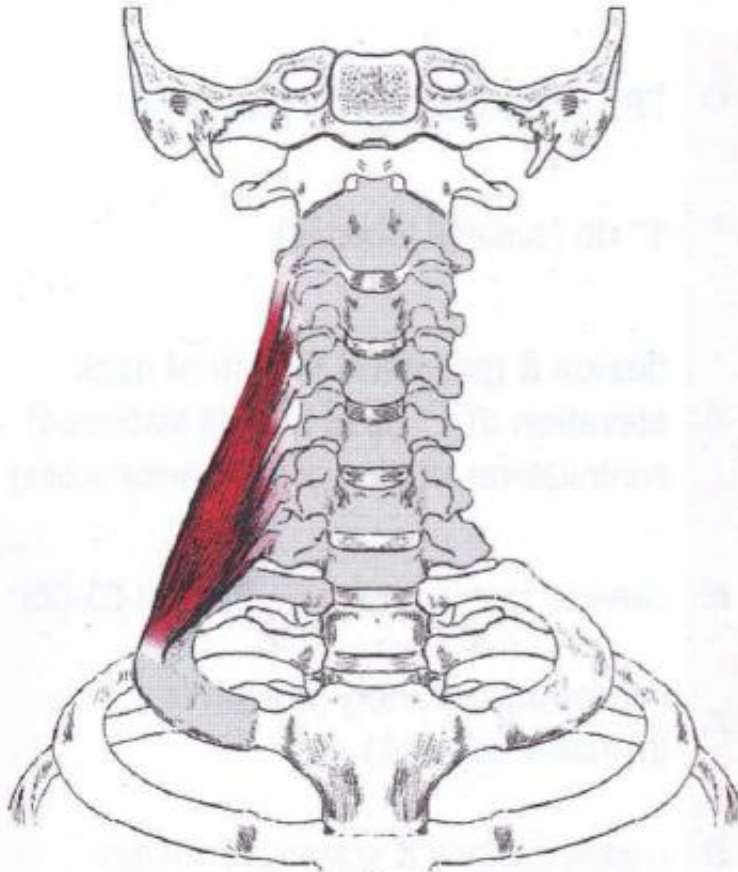
N cervical spinal nerves (ventral rami C3-C6)

B inferior thyroid artery (branch of thyrocervical trunk)

S middle scalene & scalenus minimus

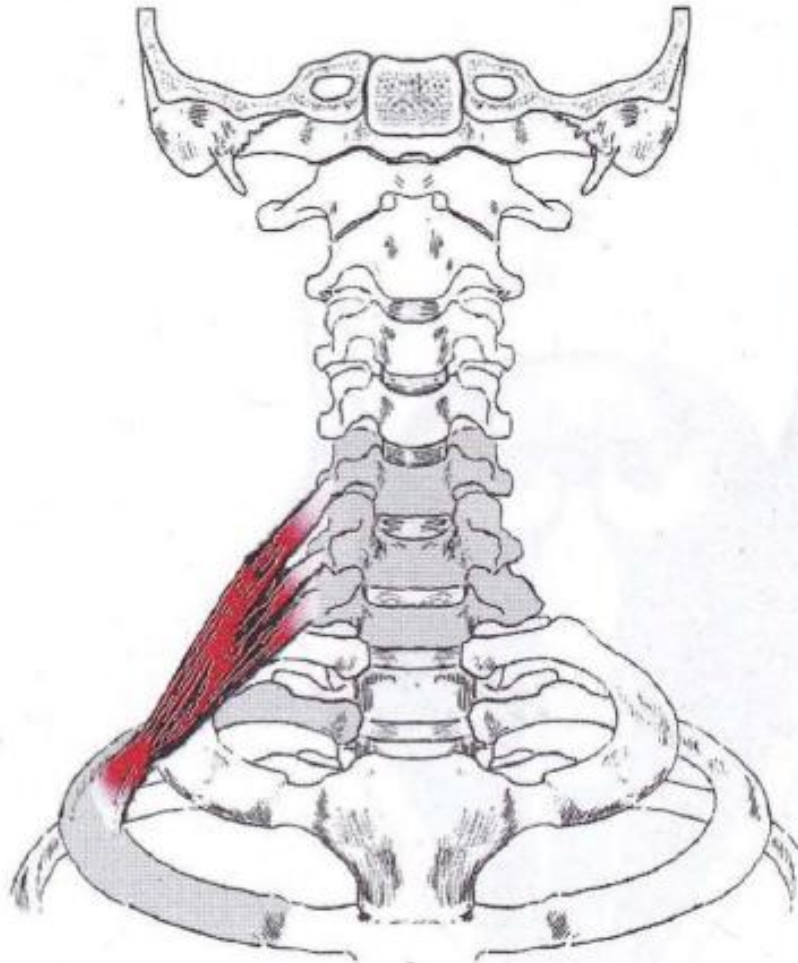
Middle Scalene

ProHealth



- O** TPs C2-C7 (posterior tubercle)
- I** 1st rib (behind anterior scalene)
- A** flexion & ipsilateral flexion of neck
elevation of 1st rib (if neck is fixed)
- N** cervical spinal nerves (ventral rami C3-C8)
- B** inferior thyroid artery
- S** anterior scalene & scalenus minimus

Clinical Notes



O TPs of C5-C7 (posterior tubercles)

I 2nd rib

A ipsilateral lateral flexion of neck
elevation of 2nd rib (if neck is fixed)

N cervical spinal nerves (ventral rami C6-C8)

B inferior thyroid artery (branch of
thyrocervical trunk)

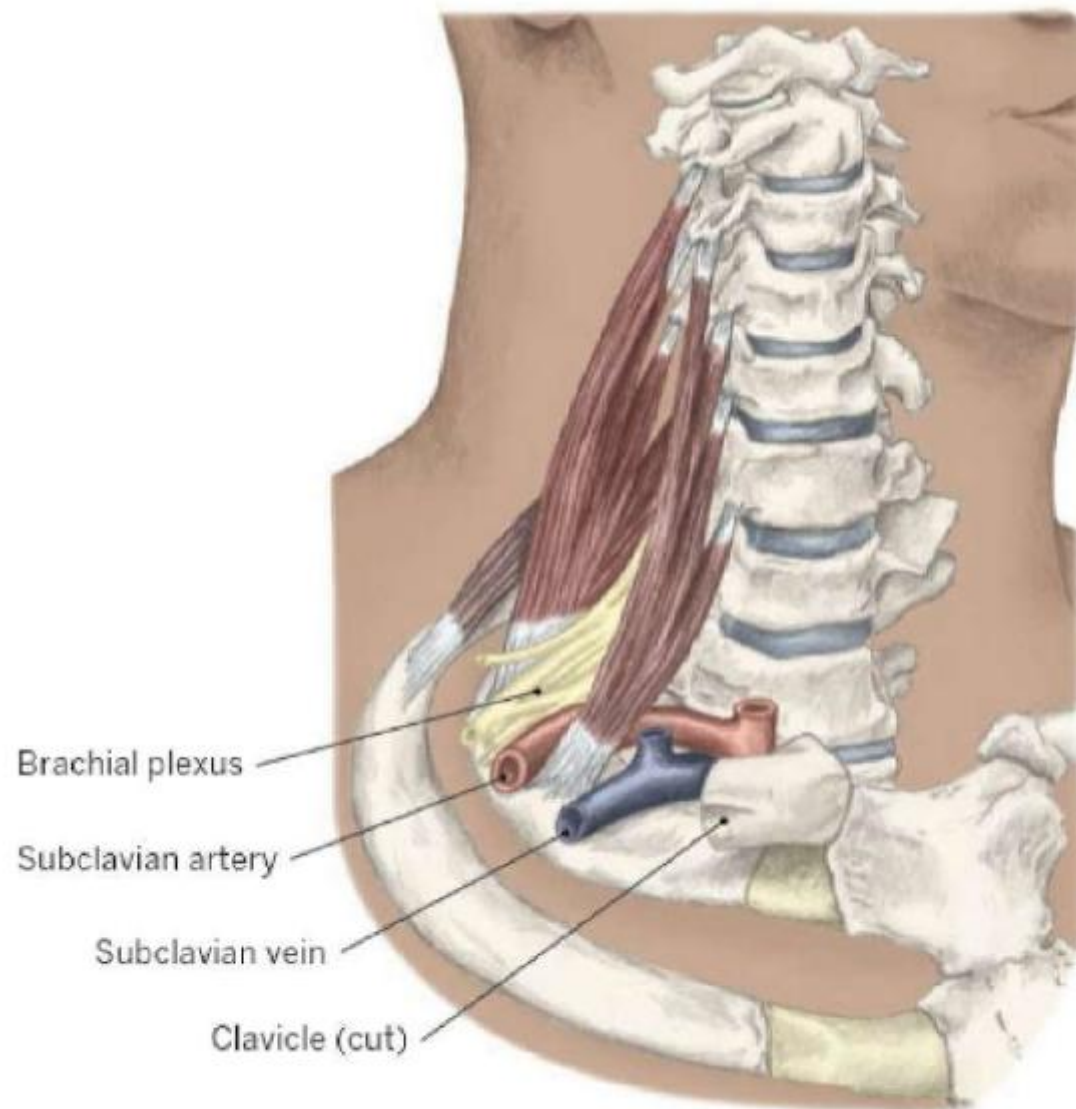
S anterior & middle scalene

Anterior Scalene Syndrome

- A common subtype of **Thoracic Outlet Syndrome (TOS)** where compression occurs in the **interscalene triangle**.

What is it?

- Compression of:
 - **Brachial plexus (especially C8–T1)**
 - **Subclavian artery**
- Caused by tight or hypertrophied **anterior scalene muscle**



5.40 Anterior/lateral view

- **Interscalene Triangle (Important Anatomy)**

- Boundaries:

- Anterior → Anterior scalene
- Posterior → Middle scalene
- Inferior → First rib

Structures passing through:

- Brachial plexus
- Subclavian artery

Subclavian vein does NOT pass here

Causes

- Scalene muscle tightness or spasm
- Poor posture (forward head)
- Whiplash injury
- Repetitive neck strain
- Accessory breathing (overuse of scalenes)
- **Pathophysiology**
- Tight anterior scalene → narrows interscalene space
- Leads to:
 - Nerve compression → neurological symptoms
 - Arterial compression → vascular symptoms

Symptoms

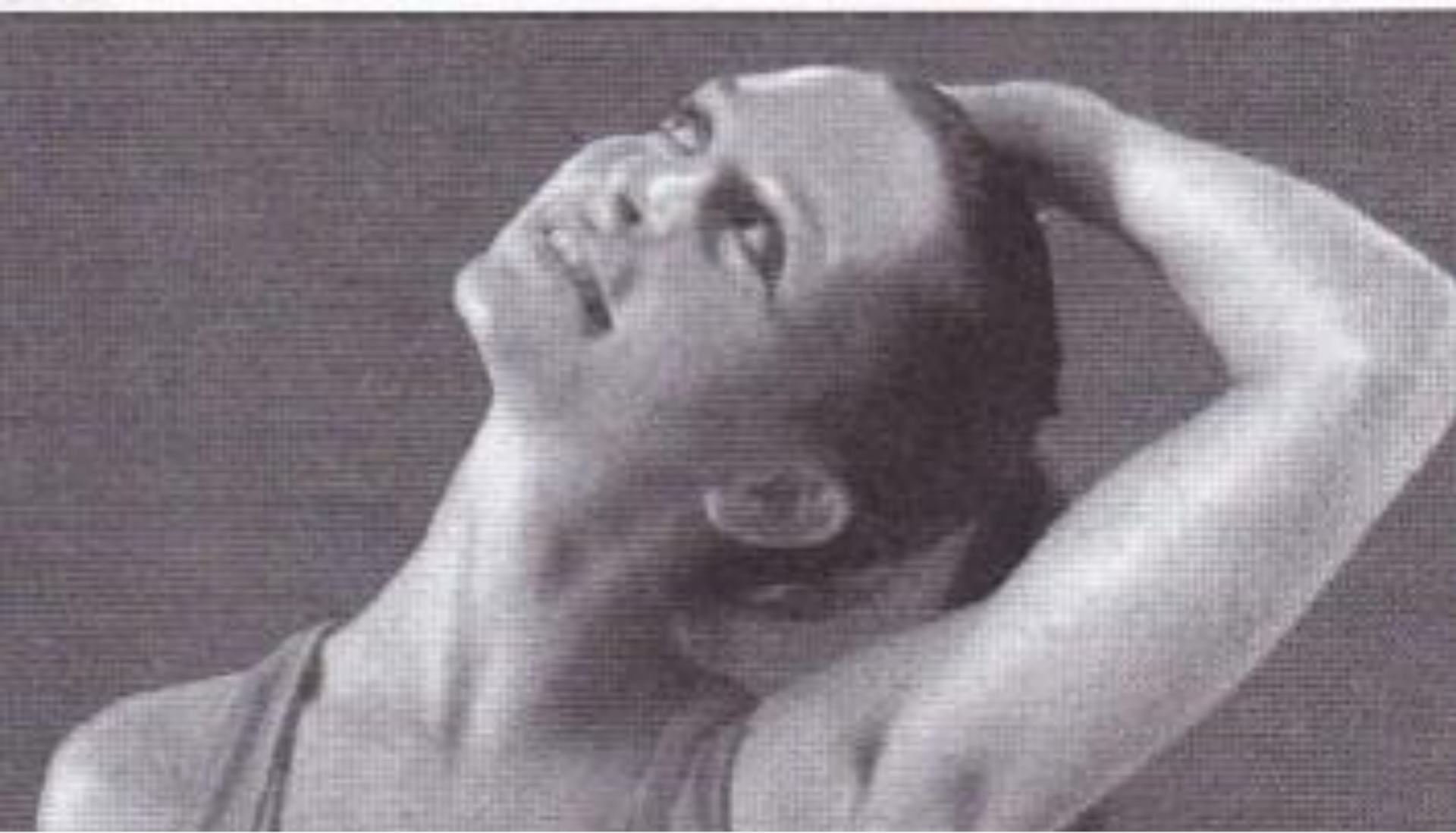
- **Neurological (most common)**
- Numbness & tingling
- Pain radiating from neck → arm → hand
- Weak grip
- Ulnar distribution symptoms (ring & little finger)
- **Vascular (less common)**
- Coldness
- Pallor or **cyanosis**
- Reduced pulse

Aggravating Factors

- Neck rotation (especially toward affected side)
- Deep breathing
- Overhead activities
- Carrying weight

ROM Findings

- Pain with:
 - Neck rotation
 - Lateral flexion

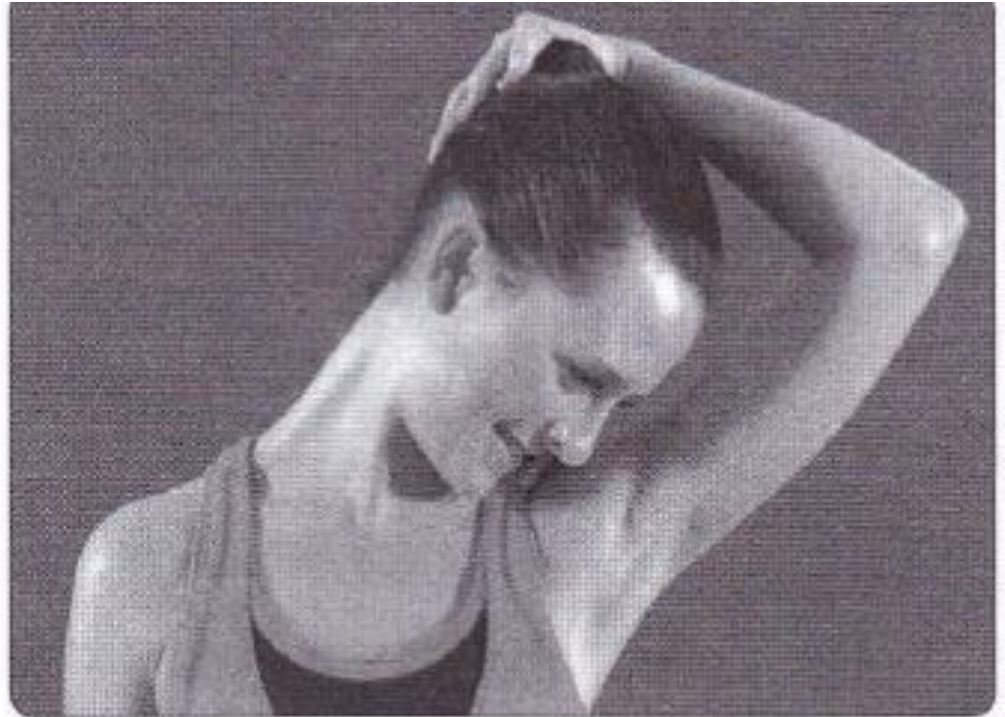


Anterior Scalene Stretch

Middle scalene stretch



Posterior Scalene Stretch



Anterior Scalene Syndrome: SOT

Adson's Test



Procedure

Patient seated, examiner palpates radial pulse bilaterally, patient is instructed to rotate head *toward* affected side; repeat looking *away* from affected side (*reverse Adson's/Halstead maneuver*)

Interpretation

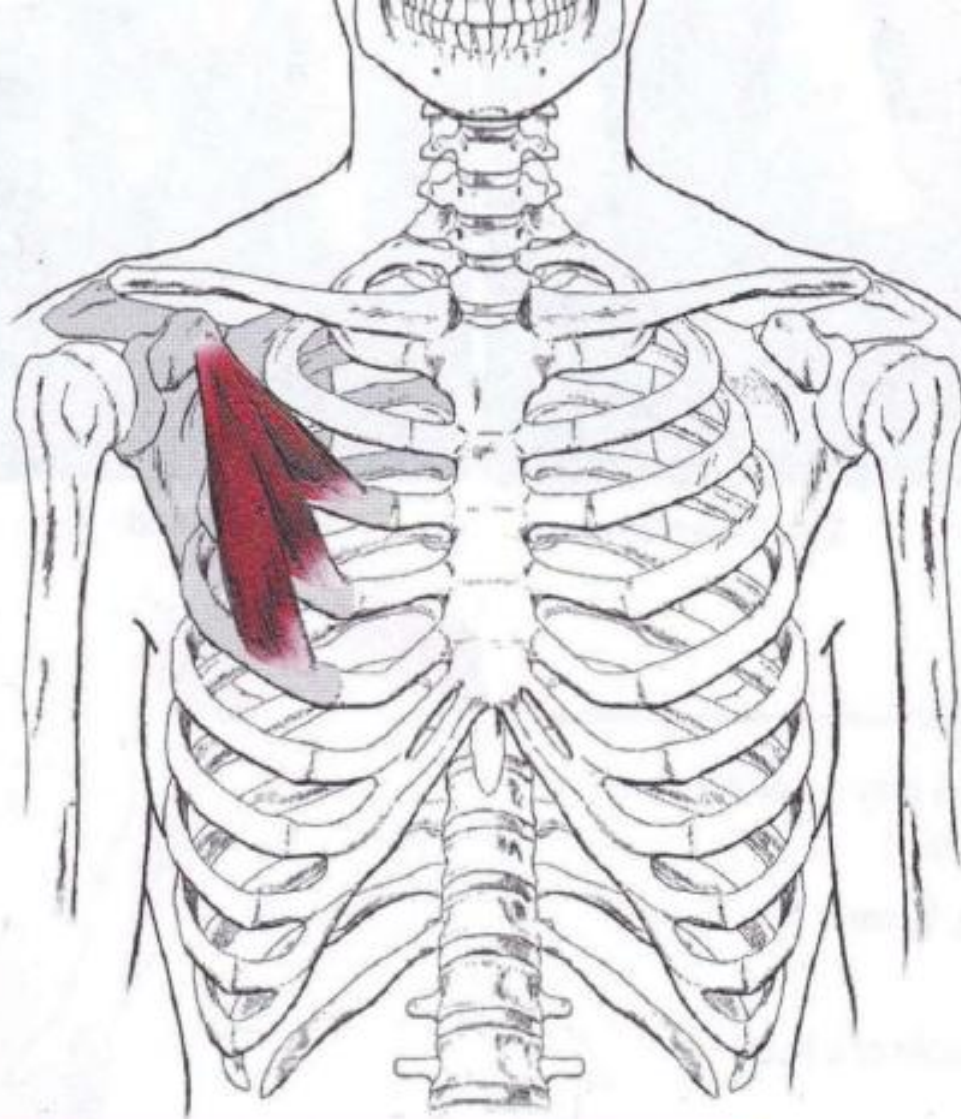
(+) Decrease/loss of pulse → neurovascular compression (TOS) from a cervical rib, scalene muscle brachial compression

Clinical notes

Patient may be instructed to take a deep breath & hold it after the head is rotated to help apply further pressure to the brachial plexus nerve roots & subclavian vessels (**SN:** 50 **SP:** 74-100)^{13, 17, 18}



- **Stretching (Very Important)**
- Scalene stretch:
 - Side bend away
 - Slight extension
 - Gentle rotation
- **Postural Correction**
- Correct forward head posture
- Improve breathing pattern (diaphragmatic breathing)
- Avoid accessory muscle overuse



I coracoid process of scapula
(medial aspect)

stabilizes scapula for arm
movements

A depresses & downwardly
rotates scapula

assists in scapular protraction
from retracted position
elevates ribs 3-5

N medial pectoral nerve (C8, T1)

B thoracoacromial trunk

S serratus anterior

Clinical Notes

- **Anatomical variation:** rarely *pectoralis minor* may attach to the 2nd rib or even the 6th rib
- Myospasm or contracture of *pectoralis minor* may cause compression of the brachial plexus & subclavian artery & vein which run between *pectoralis minor* & the anterior rib cage; this compression can cause thoracic outlet syndrome (specifically, pectoralis minor syndrome)

Pectoralis Minor Syndrome

A subtype of **Thoracic Outlet Syndrome (TOS)** where compression occurs **below the coracoid process**, in the **subpectoral space**.

What is it?

- Compression of:
 - **Brachial plexus**
 - **Axillary artery & vein**
- Caused by tight/shortened **pectoralis minor muscle**

Anatomy

- **Pectoralis minor** attaches:
 - From ribs **3–5**
 - To **coracoid process of scapula**

Compression occurs **under this muscle when it is tight**

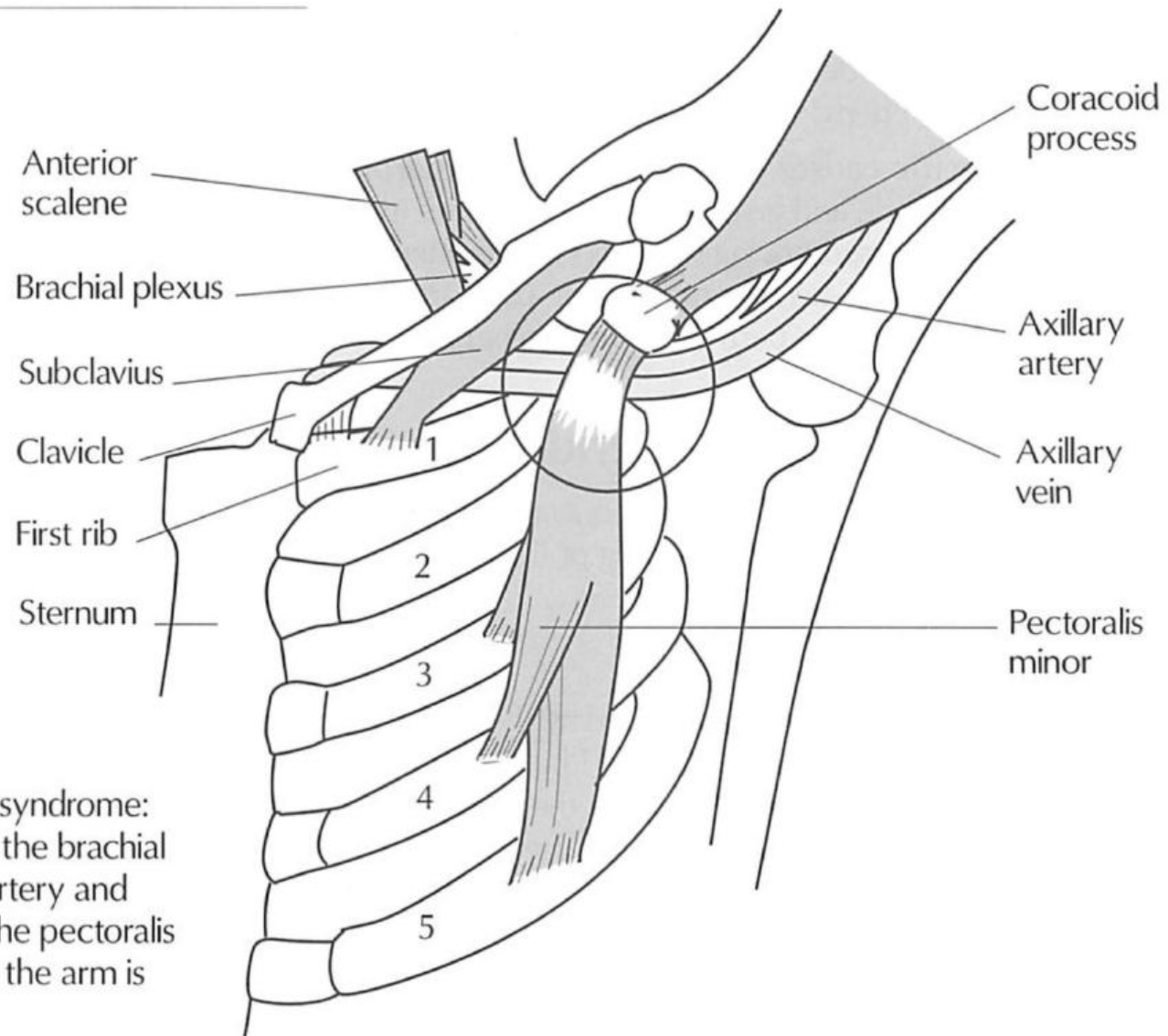


Figure 68.4
Pectoralis minor syndrome:
Compression of the brachial
plexus, axillary artery and
axillary vein by the pectoralis
minor muscle as the arm is
abducted.

Pectoralis Minor Syndrome

Causes

- Rounded shoulder posture
- Prolonged desk work
- Repetitive overhead activity
- Sports (swimming, throwing)
- Emotional stress → chest tightness

Pathophysiology

- Tight pec minor → pulls scapula **anterior & inferior**
- Narrows subpectoral space → compresses neurovascular bundle

Symptoms:

Neurological

- Numbness & tingling in arm/hand
- Pain in anterior shoulder & chest
- Weakness in arm
- **Vascular**
- Coldness
- Swelling in hand
- Possible **cyanosis**

Aggravating Factors

- Overhead arm position
- Prolonged forward shoulder posture
- Sleeping with arms overhead

Assessment

- **Postural Findings**
- Rounded shoulders
- Protracted scapula
- Increased thoracic kyphosis

Palpation

- Tight, tender **pectoralis minor**
- Trigger points referring to chest/arm

ROM Findings

- Restricted shoulder abduction
- Pain with overhead movement

Pectoralis Minor Syndrome: SOT

Wright's Hyperabduction Test

★★★★

Procedure

Patient seated or supine, examiner palpates radial pulse, then abducts patient's arm above head; repeat on opposite side (variation of test can be done by horizontally abducting the arm at 90°)

Interpretation

(+) Change in radial pulse or numbness, tingling, weakness → TOS secondary to compression under pectoralis minor muscle (sp: 38-90)^{17, 18}

Clinical notes

Realize it is a normal finding for the radial pulse to change when the arm is held above the head (many false positives)



TOS

Roo's/EAST Test

★★★★★

Synonym: EAST (elevated arm stress test), Provocative Elevation Test

Procedure

Patient seated, shoulders 90° abducted, elbows flexed 90°, examiner instructs patient to open & close fists ~2x/sec for 3 minutes

Interpretation

(+) Inability to maintain action with associated numbness, tingling or weakness → TOS (SN: 82 SP: 100)^{5, 12}

Clinical notes

Clinically 3 minute duration may not be required, typically one minute is usually enough time for patients to exhibit symptoms of TOS

Test may demonstrate many false positives (~47% in normal population)



Subjective Assessment

Ask about:

- Numbness / tingling (“hand asleep”)
- Pain location & intensity
- Aggravating / relieving factors
- Posture (sleeping, work)
- History of trauma

Postural Assessment

Look for:

- Forward head posture
- Drooping shoulders
- Hyperkyphosis
- Scoliosis

Observation

- Weak grip
- Muscle wasting
- Edema or color changes

Palpation

- Trigger points
 - Scalenes
 - pec minor
 - subclavius
- Fascial restriction (neck & chest)
- Cool Hand

ROM Findings:

- Reduced neck & shoulder ROM
- Pain with
 - Rotation
 - Lateral Flexion

Differential Diagnosis

- Carpal tunnel
- Cervical radiculopathy
- Raynaud's

Treatment Principles

- Relieve compression
- Treat cause, not symptoms
- Focus on:
 - Soft tissue
 - Posture

Treatment Goals

- Decrease compression
- Reduce muscle hypertonicity
- Improve circulation
- Decrease edema
- Improve posture

General Approach

- Treat neck & shoulder girdle
- Address:
 - Primary muscles
 - Compensatory patterns

Key Muscles

- Scalenes
- Pectoralis minor
- Subclavius
- Trapezius
- Latissimus dorsi
- Serratus anterior

Techniques

- Effleurage
- Trigger point therapy
- Fascial work
- Muscle stripping
- Joint mobilization

Specific Techniques

- Scalene stripping
- Pec minor release
- Subclavius release

Positioning

- Supine/prone
- Towel support
- Arm elevation

Hydrotherapy

- Heat for relaxation
- Cold for swelling
- Contrast baths → circulation improvement

Precautions

- Avoid aggressive techniques with:
 - Cervical rib
 - RA
 - Degenerative disc disease
- Modify pressure in fragile tissue

Self Care

- Posture correction
- Stretching
- Strengthening

ULTT 1

- **ULTT 1 (Upper Limb Tension Test 1)** is a neurodynamic test mainly used to assess the **median nerve** and its pathway

Purpose

- Evaluate **neural tension / mobility**
- Identify **nerve irritation or compression**
- Commonly used in:
 - Cervical radiculopathy
 - Carpal Tunnel Syndrome
 - Thoracic outlet issues



Patient Position

- Supine (lying on back)
- No pillow (cervical spine neutral)

Steps

- **Scapular depression** (stabilize shoulder)
- **Shoulder abduction** (~90–110°)
- **Forearm supination**
- **Wrist & finger extension**
- **Shoulder external rotation**
- **Elbow extension**
- **Cervical side flexion** (away/toward for sensitization)

- **Positive Test**
- Reproduction of symptoms:
 - Pain
 - Tingling
 - Numbness along median nerve distribution
- Symptoms change with **neck side bending**
 - ↑ symptoms → neural involvement likely

ULTT 2

- **Purpose:** To assess the **median nerve**, **Axillary nerve**, **Musculocutaneous nerve** as the source of the client's painful shoulder or arm

Performing the Test:

- Test Position: The client is in a supine position
- - Depress the client's shoulder and abduct the humerus to 10 degrees. - Slowly extend the wrist and fingers.
- - Fully supinate the forearm and extend the elbow. Tissue tightness in the shoulder or elbow, or tingling in the fingers is a normal response.
- Result:
- - A positive test is reproduction of the client's symptoms.



ULTT 3

Test Sequence:

- Scapular depression
- Shoulder abduction (10–30°)
- Elbow extension
- Medial (internal) rotation of shoulder
- Forearm pronation
- Wrist flexion + ulnar deviation
- Finger flexion



- Add **contralateral cervical side bending**
- ↑ symptoms → neural involvement
- Ipsilateral side bending → ↓ symptoms
- **Positive Test**
- Reproduction of:
 - Pain/tingling along:
 - Lateral arm
 - Posterior forearm
 - Dorsum of hand
- Difference compared to opposite side

ULTT 4

- The **ULTT (Upper Limb Tension Test)** for the **ulnar nerve**—often called **ULTT 4** or the **ulnar nerve bias test**
- **Purpose**
- To evaluate **neural tension** of the **ulnar nerve**
- Helps in conditions like:
 - Cubital tunnel syndrome
 - Ulnar nerve entrapment
 - Cervical radiculopathy (C8–T1)

- **Patient Position**

- Supine (lying on back)
- No pillow or minimal support under head
- Arms relaxed initially

- **Test Procedure (Step-by-Step)**
- **Scapular Depression**
 - Stabilize and depress the shoulder
- **Shoulder Abduction**
 - Abduct shoulder to ~90–110°
- **Shoulder External Rotation**
 - Fully externally rotate the shoulder
- **Forearm Pronation**
 - Pronate the forearm
- **Wrist & Finger Extension**
 - Extend wrist and fingers
- **Elbow Flexion**
 - Flex the elbow fully
- **Final Sensitizer**
 - Add **contralateral cervical side flexion** (away from tested side) to increase tension
 - Ipsilateral side flexion reduces symptoms



ULNT

ULNAR

- Wrist/finger extension
- Forearm pronation
- Elbow flexion
- Shoulder external rotation
- Shoulder girdle depression
- Shoulder abduction
- Structural differentiation
 - Cervical sidebending
 - Release shoulder girdle depression
 - Release wrist extension

- **Positive Test**
- Reproduction of:
 - Tingling, numbness, or pain along ulnar distribution:
 - Medial forearm
 - Little finger & half of ring finger
- Symptoms change with **neck side bending**



ULNT1_{MEDIAN}

- Shoulder girdle stabilization
- Shoulder abduction
- Wrist/finger extension
- Forearm supination
- Shoulder external rotation
- Elbow extension
- Structural differentiation
 - Cervical sidebending
 - Release wrist extension



ULNT2_{MEDIAN}

- Shoulder girdle depression
- Elbow extension
- Shoulder external rotation and forearm supination
- Wrist/finger extension
- Shoulder abduction
- Structural differentiation
 - Cervical sidebending
 - Release shoulder girdle depression
 - Release wrist extension



ULNT_{RADIAL}

- Shoulder girdle depression
- Elbow extension
- Shoulder internal rotation and forearm pronation
- Wrist/finger flexion
- Shoulder abduction
- Structural differentiation
 - Cervical sidebending
 - Release shoulder girdle depression
 - Release wrist flexion



ULNT_{ULNAR}

- Wrist/finger extension
- Forearm pronation
- Elbow flexion
- Shoulder external rotation
- Shoulder girdle depression
- Shoulder abduction
- Structural differentiation
 - Cervical sidebending
 - Release shoulder girdle depression
 - Release wrist extension